US Army Corps of Engineers.
Construction Engineering Research Laboratory

U.S. Army CERL
P.O. Box 9005
Champaign, IL 61826-9005

Public Affairs Office
Phone: (217)-352-6511
Fax: (217) 373-7222
http://www.cecer.army.mil

Fact Sheet

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NITROCELLULOSE FINES MANAGEMENT STRATEGY

The Problem

Nitrocellulose (NC) is a basic constituent of military-grade propellant. Radford Army Ammunition Plant, VA (RAAP) generates NC fines containing wastewater from NC purification processes. With full production capacity, RAAP discharged 3.5 million gal of NC wastewater per day, which contains about 2000 lb of NC fines. Currently, NC fines are separated from wastewater by settling and centrifuges. The NC fines are then recovered and reused as "pit cotton." If the State of Virginia imposes more stringent effluent limitations, RAAP will have to develop a new NC fines removal technology. Furthermore, the Army is seriously considering terminating the reuse of pit cotton and will consequently need to develop some other technology for reuse or treatment. By definition, if NC is wasted, NC fines are hazardous. Open burning and open detonation (OB/OD) are no longer acceptable disposal methods. The current method for disposal of waste NC relies on incineration, at a high unit cost–almost the same as the cost to produce virgin NC.

NC fines separation is difficult because the fine sizes vary widely, from sub-micron to a few millimeters, and because wastewater is corrosive and hot. Furthermore, stringent military specifications make reuse difficult. There was a need for a holistic approach to develop a new, in-depth understanding of pollution prevention, separation, treatment, and disposal methods for NC fines.

The Technology

The U.S. Army Construction Engineering Research Laboratory (CERL) has comprehensively developed /evaluated a number of technologies to separate, reuse, treat, and dispose of NC fines, mostly in a bench-scale laboratory environment. They include:

Pollution Prevention / Separation of NC Fines. Since existing centrifuges cannot effectively remove NC fines, the use of microfiltration/ultrafiltration was evaluated. CERL found that the optimum membrane pore size was a 100K molecular weight cutoff. CERL recommended a pollution prevention approach, in which NC fines are recycled at the purification processes before NC fines are mixed with other kinds in the settling pits. Under Environmental Science and Technology Certification Program (ESTCP) (FY98-99), CERL shows that ceramic membrane ultrafiltration systems can effectively separate/recycle NC fines.

Treatment of NC Fines. CERL research optimized alkaline hydrolysis of NC fines. Overall treatment costs were analyzed considering selection of alkaline material, its dosage, heating requirements for better reactions, and also biological treatment of hydrolysate. Acid hydrolysis of NC fines is a new concept developed under CERL's efforts. NC fines were converted to glucose and alcohol using strong acid hydrolysis. The acid was recycled by electrodialysis. A patent was granted for this process in December 1998. This process may be competitive with other treatment processes when NC disposal costs

rise. NC in water is a biologically recalcitrant material. CERL found that NC may be degraded from 13.5% nitrogen to 11% nitrogen within a month under anaerobic (methanogenic) conditions. This rate of degradation was not satisfactory for immediate implementation. Other treatment processes evaluated included ultraviolet degradation, laser, alkaline hydrolysis, and ozone and hydrogen peroxide oxidation. These technologies remain as options depending on concentrations and costs at the time of implementation.

Disposal of NC Fines. If the Army terminates the reuse of pit cotton, RAAP will have a NC disposal problem. Since OB/OD is not a choice disposal method, the current alternative is costly incineration. One of the appropriate treatment methods above will allow the Army to dispose of NC at lower costs. One promising disposal method is alkaline hydrolysis / neutralization / land application as a soil amendment.

Benefits/Savings

The Army now has the technical alternative baselines to begin implementation of NC fines management strategies. The need for these new strategies will become critical if the State of Virginia imposes more stringent effluent limitations or when the Army determines to terminate the reuse of pit cotton. The savings will be enormous compared with regulatory fines. If 2,000 lb of NC per day is recovered /reused, the annual savings will be $1.6 million assuming $2/lb virgin NC production increase and $2/lb incineration cost savings.

Status

CERL's research has shown that the Army now has the capability to solve NC fines compliance problems. The above technologies will be further validated. During FY97-FY99, CERL and the U.S. Army Armament Research, Development, and Engineering Center (ARDEC) are working on pilot scale evaluation of ceramic membranes under Environmental Security Technology Certification Program (ESTCP).

Although there is a high user requirement for NC fines disposal technologies, technology implementation has been is slow because the NC production rate has been substantially reduced in the past few years.

More information is available in CERL Technical Reports (TR); TR EP-95/04, *Evaluation of Crossflow Microfiltration for Removing Nitrocellulose Fines from Wastewater* (April 1995); TR 97/116, *Comparative Evaluation of Ultrafiltration/Microfiltration Membranes for Removal of Nitrocellulose (NC) Fines from Wastewater* (July 1997); TR 97/138, *Characterization of Nitrocellulose Fines in Wastewater and Development of Pollution Prevention Strategy* (September 1997); TR 98/65, *Alkaline Hydrolysis/Biodegradation of Nitrocellulose* (August 1998); and TR 99/45, *Anaerobic Digestion and Acid Hydrolysis of Nitrocellulose* (April 1999).

Point of Contact

CERL POC is Dr. Byung Kim, COMM 217-373-3481; toll free 800-USA-CERL, X-3481; FAX 217-373-3490; e-mail: b-kim@cecer.army.mil; or CERL, ATTN: CECER-CN-E, P.O. Box 9005, Champaign, IL 61826-9005.

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